No. 254 BULLETIN OF THE Reprinted March, 1947
OHIO STATE UNIVERSITY AGRICULTURAL COLLEGE EXTENSION SERVICE

BEES
for
Honey Production and Pollination

Swarming, the natural method of bees to establish new colonies, is not conducive to honey storage. Swarm prevention and control are a part of good apiary management.

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THE OHIO STATE UNIVERSITY AND THE U. S. DEPARTMENT OF AGRICULTURE, COOPERATING
AGRICULTURAL EXTENSION SERVICE—H. C. RAMSOWER, *Director*, Columbus, Ohio
Printed and distributed in furtherance of the Acts of May 8 and June 30, 1914

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BEES

for

HONEY PRODUCTION AND POLLINATION

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Fundamentally, the most important economic work of honeybees is pollinating plants. Thus, honey and beeswax must be considered by-products of pollination.

The beekeeper's primary interest is that of honey and beeswax production as a means of gaining a livelihood, supplementing his income, or in many cases as a hobby. In order that the beekeeper make a profitable enterprise in honey and beeswax production, he must apply sound beekeeping practices which will result not only in colonies of bees with large bee populations, but also in the stimulation of maximum nectar and pollen gathering activities in the field. Thus, while the beekeeper is achieving his goal in more honey and beeswax, he also is aiding agriculture in its more important goal of increased insect pollination.

The annual value of the pollinating service rendered by honeybees is many times the value of the honey and beeswax produced. Directly and indirectly, insect pollination contributes many millions of dollars in producing plants and plant products for human and livestock consumption, and is necessary in the production of large yields of legume seed. The growing of legumes is the most economical method of maintaining a high nitrogen and humus content in our soils.

. . . FACTORS CONTROLLING COLONY POPULATION . . .

The success of a beekeeper depends largely on his ability to maintain colony strength and to build large bee populations for the major nectar flows. Reasonable control of the bee population of a colony during any period of the year is essential in the profitable management of bees. A brief discussion of the factors determining the population of a colony follows:

1. The Queen.—At all times the colony must be headed by a strong vigorous queen having the capacity of heavy egg laying, and whose progeny possesses longevity, vigor, nectar and pollen gathering qualities, resistance to diseases, and gentleness.

2. Worker Bees.—There should always be enough bees present in a hive to encourage normal egg laying by the queen, and to perform the normal duties inside and outside the hive. The number of worker bees desirable in a hive varies with the seasons and with the type and number of major nectar flows common to a given region.

3. Food.—Honey should always be amply provided and be in excess of the actual needs of the bees. Honey supplies their carbohydrate requirements. Pol-

len supplies the protein, minerals, and vitamins necessary for a properly balanced diet and for the developing of young bees. The bulk of the pollen is stored in the combs by the bees, although some pollen grains are dispersed in the honey. The modern beekeeper attempts to have adequate pollen reserves in the hive, but in many cases these prove to be insufficient in quantity. The lack of pollen during certain periods of the year seriously affects normal development of colony populations.

4. Room.—The needs of the queen and bees for comb space vary during the year. There should always be ample comb space of high quality to meet the egg laying requirements of a normal queen. Room for the worker bees is equally important, since at all times they should have ample combs for the storage of nectar and pollen, as well as adequate room for the bees to "park" during periods when they are confined to the hive.

5. Protection.—Colonies should be located so that they are protected by shrubbery or woods from prevailing winds. Shade from trees during the heat of the summer days is beneficial. Insulation around the hives during the winter and early spring will help to maintain colony strength during the winter and aid in a more rapid build-up of colonies during the spring.

6. Ventilation.—Ventilation is especially important during the summer nectar flows and periods of high temperatures. The entire entrance piece should be removed to allow for proper air conditioning by the bees during the summer months. Additional ventilation can be provided by "staggering" the top super ¼ inch.

7. Floral Forage.—The acreage of bee forage is governed largely by the weather, the chemical and physical properties of soils, and the land utilization program of a region. These factors determine the honey producing possibilities of a region, and each beekeeper should learn the limitations of his own territory. Beekeepers have little control of the pasturage for bees. The only practical control of the commercial beekeeper is to move his apiaries to proven commercial beekeeping areas.

8. Weather.—While the climatic conditions in the North Central States result in greater winter losses of bees than in Southern States, nevertheless, the climate is more favorable for nectar flows of greater intensity and honey of the finest quality. Although the beekeeper has no control of the weather, he can, through skilled management of his bees, make them sufficiently independent of average weather conditions. This management consists of providing protection, supplying an abundance of stores of honey and pollen, and seeing that the bees have the correct amount of room during the winter, spring, and fall.

Favorable weather when the main honey flows occur has much to do in determining the size of the honey crop. For best results, the weather must be favorable for bee flight and for copious secretion of nectar by the plants. Even in years when the plant forage is scant, if climatic conditions are favorable for nectar secretion, a sizable crop of honey may be harvested. Bumper honey years occur when the weather is ideal for the bees and the plants, and when there is an abundance of blooming forage.

The Beekeeper's Year

The beekeeper's year is divided into four periods: the Spring Period, the Harvest Period, the Fall Period, and the Winter Period. Each period is a unit and the beekeeper must plan and execute his work to meet the seasonal conditions and the conditions of his colonies if he is to be successful in his production of honey.

The "Beekeeper's Calendar (pages 16 and 17) is supplemented by narrative material in an attempt to present a clear, simplified picture of the main problems involved in the year's management of colonies of bees. These management phases are broken down into seasonal periods to further simplify practices which are essential in the control of the population of colonies and the harvesting of maximum crops of honey.

. . . THE SPRING PERIOD . . .

In areas where the bulk of the surplus honey is harvested from clover, the management during the spring hinges around developing colonies that will reach their maximum number of bees at the beginning of the harvest period. There are only from 8 to 11 weeks during the spring to develop colonies of proper strength before the clover flow starts. Unless the limiting factors are corrected promptly in abnormal colonies, they will not have time to attain the desired population and may produce little or no surplus honey. Commercial beekeepers have from $18 to $25 invested per colony. They find it necessary that practically 100 per cent of their colonies be of productive strength at the begin-

Fig. 1.—A yard of over-wintered colonies as seen in the spring.

ning of the clover flow, if they are to realize the greatest return from their capital investment.

First Spring Inspection

Colonies should be examined between April 1 and 10, during the warm days when the temperature is not below 65 degrees Fahrenheit. By such an early inspection there will be sufficient time to condition colonies that otherwise would not develop properly (Fig. 1). The following factors should be checked at this time and adjustments made, if any abnormal conditions are encountered:

The Queen.—The frames in the central area where the bees are clustered should be inspected. There should be from three to five frames of brood in

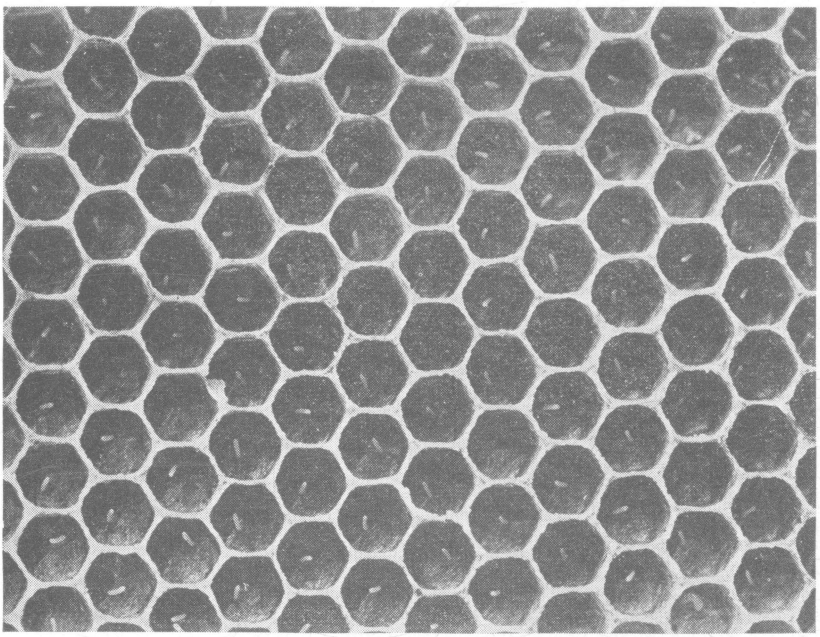


Fig. 2.—Close view of eggs deposited compactly in the comb.

normal colonies. The first evidence that the queen is present is eggs deposited in the worker cells. The point to check as a means of determining if the queen is vigorous is the compactness of her egg laying and the quantity of brood present (Fig. 2). If egg laying is scattered over the frames containing brood and there are many intervening empty cells, the queen cannot be depended on to carry on the heavy egg laying necessary to build a large populated colony. The number of frames containing brood at this time of year depends on the size of the colony and the weather.

If there are no eggs or brood found on the first inspection, the colony should be united by the "newspaper method" to a colony of medium or better

in strength (see page 22). Another method would be to unite a 3-pound package of bees with a queen to such a colony.*

In the case of a colony of good strength containing emerging brood, but where it is evident that the queen is failing or perhaps has just recently disappeared, it is advisable to introduce a purchased queen from the south (see page 29). Since there will be an eggless period until the new queen starts laying, such a colony will usually need help to build it to storing strength. This can be done advantageously by interchanging its location with an extra strong colony during the early part of the dandelion-fruit bloom; be sure nectar is coming in freely when this is done. The large field force from the extra strong colony will augment the population of the colony containing the new queen, so that she will be stimulated to maximum egg laying capacity and thus assure a strong colony for the clover flow.

Number of Worker Bees.—The minimum standard of strength necessary to develop dependable colonies of bees under normal spring conditions is at least four or five frames of bees. Any colony under this strength on April 1 to 10 should be strengthened. This can be done by three reliable methods, namely: (1) By the use of queenless packages of bees, (2) by interchanging the location of the weak colony with that of the strong colony at the beginning of the dandelion-fruit bloom, or (3) by drawing frames of emerging brood from extra strong colonies and placing them in a weak colony. The first two methods are safe and effective. The third method, that of giving frames of emerging brood to weak colonies, is perhaps the best way to strengthen weak colonies, but it is the most dangerous method, especially for beginners, because of the hazard of spreading disease among the colonies. This method is not recommended to the beginner, and the skilled beekeeper should use it with much discretion.

The use of queenless packages of bees is the best method of strengthening colonies on the first inspection trip. On later inspection trips, other methods can be resorted to which will draw on the extra strong colonies without harm to them. The goal during the spring is to have all colonies develop into good storing strength by early June and also

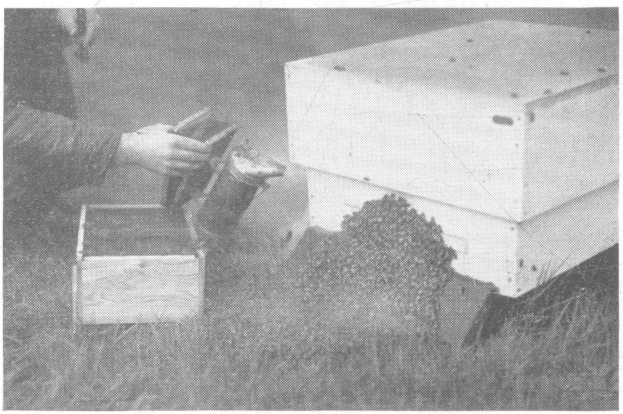


Fig. 3.—Dumping gorged queenless bees at the entrance of a weak colony. Several puffs of smoke at the entrance of the weak colony is necessary at this time.

* Package Bees for Honey Production—Bulletin 159, Agricultural Extension Service, The Ohio State University, Columbus, Ohio.

to have all colonies as uniform in strength as possible. For safe methods of uniting queenless packages of bees, refer to our bulletin entitled "Package Bees for Honey Production" (see Fig. 3).

STORES.—The term "stores" refers to the honey and pollen in a hive. The amount of stores that should be present in a normal colony at the beginning of spring is influenced by the normal spring forage of any given area. In an average clover region, there should be the equivalent of a shallow food chamber, which would be about 35 or 40 pounds. In some areas a normal colony should have a deep food chamber containing from 50 to 60 pounds of stores, along with what nectar the bees gather from spring blooming plants. A colony should never have less than the equivalent of three solid deep frames of honey, which is equal to from 15 to 20 pounds.

A deficiency of honey in the hive can be corrected by feeding sugar sirup in the proportion of 1 part of white granulated sugar to 1 part of hot water.

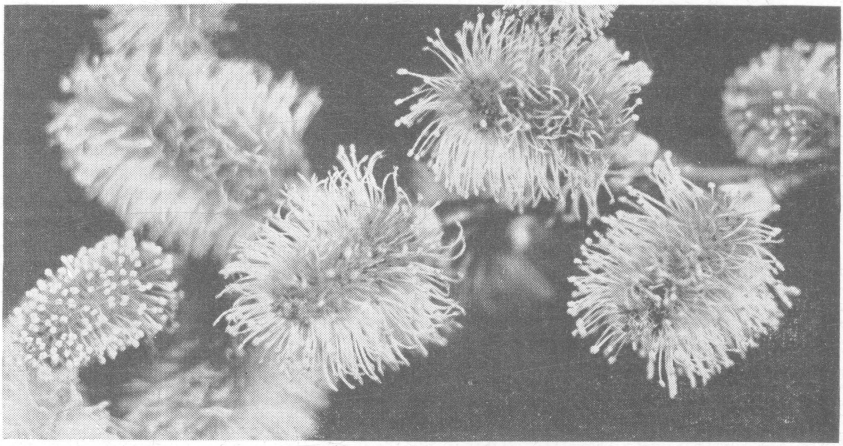


Fig. 4.—Pussy-willow bloom supplies abundance of natural pollen.

Frames of honey can be used, but there is the hazard of scattering disease—only experienced beekeepers should practice the exchanging of frames of honey.

There should be a good supply of pollen in the combs early in the spring, although this is seldom the case. If the spring weather permits free flights, the bees usually can gather enough pollen to supplement that in the hive (Fig. 4). In cases of a low supply of pollen in the combs and especially when weather prevents the bees getting pollen freely in the field, a pollen substitute may be supplied. The Federal Bee Culture Laboratory has experimented and developed a dependable pollen substitute for bees. Information on this subject can be obtained from the Federal Bee Culture Laboratory, Beltsville, Maryland. Also, information on this subject can be obtained from the Minnesota Experiment Station, St. Paul, Minnesota.

ROOM.—As far as comb space is concerned, a 1½- or 2-story hive will provide, under average conditions, adequate breeding, storage, and parking

space for the bees up to the beginning of fruit-dandelion bloom. Strong colonies in 1-story hives should have a hive body of drawn combs of good quality added about April 20 (Fig. 5). An under-strength colony should not be provided with extra breeding space until it becomes at least medium in strength and contains five or six frames of brood.

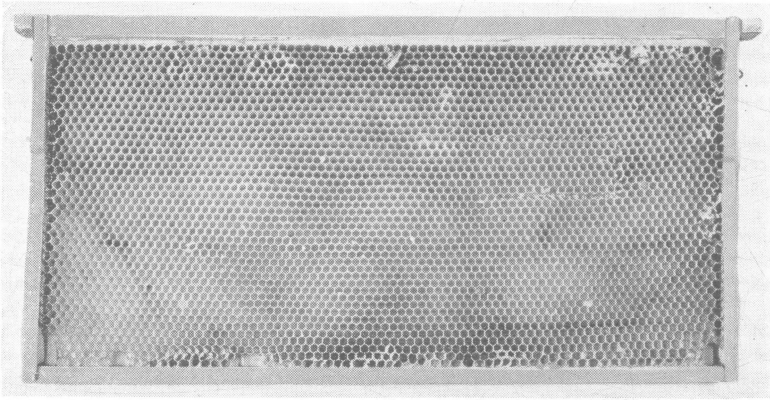


Fig. 5.—A nearly perfect brood comb representing the quality of comb space that should be in the brood-nest.

PROTECTION.—Colonies that were protected from cold by packing should have the top packing removed on this first inspection, and then replaced. Packing should be left on the colonies until just before the dandelion-fruit bloom starts (Fig. 11). By so doing, the packing helps to conserve the heat produced by the colony and it will brood better. A commercial beekeeper with a number of colonies should start unpacking them in time to finish the job by dandelion-fruit bloom time.

CLIPPING THE QUEEN'S WINGS.—On warm days during April, the beekeeper should clip the queen's wings in each colony. The colonies contain fewer

Fig. 6.—Filling 10-pound pails with sugar sirup to be fed to colonies short of stores.

bees then than at any later date and the operator can find the queens quickly. If the bees start robbing, the operator should stop work for that day. The successful beekeeper always plans to get as much of this work completed as possible during April, and to finish it during the dandelion-fruit bloom.

The following method of keeping track of the age of the queens will prove helpful. Clip the left wing of queens reared last year (1943); clip the right wing of queens raised this year (1944); and, when an old queen is found with her left wing clipped in 1945, clip her right wing. It is seldom advisable to keep queens more than two years, and only when her colony has shown unusually good production and other outstanding qualities. The best of these old queens can be used as breeders. The drones from the colonies headed by old queens will help in improving the quality of the beekeeper's stock.

When clipping the wing of a queen, cut it off about two-thirds from the tip. The clipping serves two purposes: (1) it is a check on her age; (2) it is a swarm control measure. If the colony swarms, the bees will return to the hive because the queen cannot accompany them.

Checking for Disease.—When going through colonies in April, the beekeeper should check the frames of brood for the presence of sacbrood and American foulbrood. It is not difficult to distinguish these two brood diseases. Most counties in Ohio have a bee inspector who will check colonies for disease. If disease is found, the colony should be burned.*

Second Spring Inspection

The second inspection should begin (weather permitting) the last week in April and should be completed by the second week in May. By this time, the weakest colonies should have three or four frames of brood and the bulk of the other colonies should have from six to eight frames of brood. Such a condition of colony strength is about right to insure the best type of colonies for the harvest period that usually begins June 8 to 15.

Inspect all colonies again for disease. Brood rearing will have progressed far enough at this time to permit a thorough inspection. Examine all frames containing brood. A better job of inspection can be made if the bees are shaken off the brood frames inside the hive; then one can see the disease more easily if it is present.

During the last week in April and until the dandelion-fruit-mustard bloom is over there will be (normally) plenty of nectar and pollen gathered to insure maximum brooding activities.

Room for breeding, storing, and "parking space" for the bees may be too small for the bees to develop populations and colony morale desirable for the coming major flow. Colonies possessing only three or four frames of brood should be interchanged in location with extra strong colonies—this is not to be done until nectar is coming in freely. If such colonies are in 1-story hives, a

* Diagnosing Bee Diseases in the Apiary, Circular 392, U.S.D.A.

second hive body of drawn combs, preferably dark in color, should be added at this time.

Colonies in 1- or 1½-story hives having five or more frames of brood should have a second hive body of combs added. In the case of the 1½-story colonies, the second hive body is added between the deep hive body and the shallow food chamber. With the 2-story hives, containing five or more frames of brood, the hive bodies should be reversed—that is, the upper hive body is placed on the bottom board of the hive and the hive body previously occupying the lower position placed on top. Where 2-story colonies are extra strong, a third hive body of combs is added on the top position of the colonies.

The supplying of breeding space, as recommended above, results in stimulating the queen to lay heavily, and in addition the bees have adequate room to store the nectar and pollen they bring in.

There are other miscellaneous items that should be considered. The vigor of the queens should again be checked. Young queens from the south should be introduced in any colony where the queen has disappeared or shows signs of weakening. All the queens should have their wings clipped at the end of this period.

The entrance piece of the hive should be removed from all colonies that are of medium strength or better, so that adequate ventilation will be provided.

Third Spring Inspection

About May 10, a queen excluder should be placed on top of each colony and an extracting super containing drawn combs should be given to all colonies rated as medium or better in strength. This will provide storage room for nectar as well as plenty of room for the increasing population of the colony. In an average year, by May 10, the dandelion flow will be fairly well over. Any colonies that are still weak should again be interchanged in location with extra strong colonies.

From May 15 until the clover flow commences is a critical time, and all the needs of the colonies should be well supplied. Unless there is plenty of honey in the hives, brood rearing will be curtailed. Lack of honey can be made up by supplying sugar sirup (Fig. 6). Lack of pollen may be a limiting factor in the continued development of the colony during this period. This can be corrected by supplying a pollen substitute to the colonies.

The consumption of honey and pollen is exceptionally heavy during the two weeks previous to the clover flow. This is because of the large population of colonies and also the large quantity of brood in the hives. Ten to 18 frames of brood in a colony is not uncommon just previous to the clover flow. When we consider that for each frame of brood reared, the nurse bees consume one frame of honey, it is evident that a large supply of food must be available.

Many a beekeeper has lost a honey crop because he did not give proper attention to his colonies during the last "lap" before the major honey flow. Many colonies starve during this time, and other colonies are so weakened from starvation rations that they are valueless for the harvest period.

. . . THE HARVEST PERIOD . . .

The goal to attain during the harvest period is to manage the colonies so that the maximum surplus honey will be harvested. There are three main problems to solve in order that maximum production will result. These are: (1) prevention and control of swarming, (2) maintenance of colony morale, and (3) supplying storage space in the right quantity at the proper time.

Swarm Prevention and Control

Swarming is the natural method for bees to establish new colonies, and usually occurs under prosperous conditions prevailing during a major nectar flow. Some strains of bees are more prone to swarm than others. Many of these undesirable strains have been eliminated by the beekeeper, because in modern honey production it is not desirable to have bees swarm. The conditions within the hive which bring about preparations for swarming are not conducive for good honey storage. Supplying plenty of breeding space for the queen, an abundance of space for the bees, and the presence of a vigorous queen usually prevent a colony from making preparations to swarm.

When the bees start queen cells in a normal colony, the swarming impulse is active; swarm control measures must be applied or the colony will swarm. When queens fail during the honey flow, especially during the first half of the flow, the bees start queen cells to replace the worn-out queen. When these queen cells are capped over, a colony will often swarm, especially if it is producing comb honey. Such a condition is not called natural swarming. In the application of swarm control measures, differentiation must be made between a colony preparing to swarm under *natural conditions* and one preparing to swarm due to the *queen being superseded* in the colony. In extracted honey production, where adequate breeding and storage space is available, there is evidence that swarming seldom occurs due to supersedure of the queen, if her wings have been clipped.

Maintenance of Colony Morale

Colony morale may be defined as the intensity of the instinct of bees to gather nectar and pollen to the full extent of their ability. This morale is dependent entirely on the skill and ability of the beekeeper to manage his colonies so as to stimulate maximum gathering activities.

One of the chief factors at the beginning of the clover flow which stimulates good morale of the colony is the promptness with which the bees occupy the supers and start storing in them. Unless the bees enter the super room there will be congestion which will slow up the colony and even stimulate it to start swarming preparations. A factor not mentioned in literature is the "training factor," or getting the bees into the upper supers previous to the beginning of the flow. This can be accomplished by placing the first supers on the colonies at least a week or more before the flow starts. If the colony has developed properly, the population of the colony will be large enough so that the natural reaction of the bees from the standpoint of their comfort will be to "spread out" into

the super storage space. If this has been accomplished, the bees will go to work with a vengeance as soon as the flow starts (Fig. 7).

Much damage can be done to colony morale if super space is added too freely and in the wrong position. When supering by the orthodox method, that is, if each new super is placed over the queen excluder, too much storage space may be disastrous. If this method of supering is followed, it is vital to add only the amount of room that the bees will cover well. This is especially true with colonies of medium strength, or under. The top-supering method eliminates the hazard of over-supering.

Lack of ventilation is one of the quickest ways of breaking down colony morale. The entire entrance piece should be removed so that the bees have a full entrance. In years of extreme heat, additional ventilation can be provided by staggering the top-super so that there will be about a ¼-inch opening across the entire front and back of the hive.

The application of sound swarm prevention measures and the supplying of adequate storage space determine largely the colony morale of a production unit.

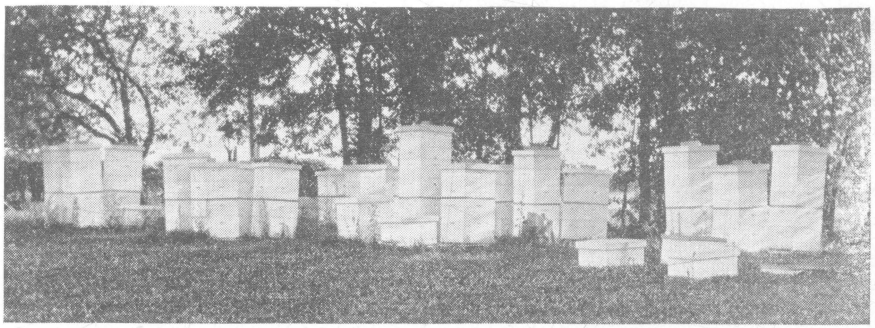


Fig. 7.—Extracting supers stacked over colonies just previous to the clover flow.

Adequate Comb Space Essential.—Lack of storage space and room for the bees themselves can bring about poor storage by the colony. If the bees have the storage combs nearly filled and there is not adequate comb space to ripen the incoming nectar, the whole activity of the colony will be slowed down. Also, under such conditions, the cells of the combs have been built out so that only a bee passage exists between the combs. This means, in a well populated colony, that the bees need more "elbow room" and space so they can "fan their wings" to bring about the proper air conditioning of the hive.

The lack of super room also means that more nectar is *crowded* into the *brood nest* and more bees forced into this area of the hive. These latter conditions mean that the queen will be crowded for egg laying space and that the congestion of bees in the brood nest also obstructs her freedom over the brood combs. Mention also should be made of the fact that the newly emerging bees tend further to congest the normal activities of the brood nest.

VALUE OF "BURR COMBS."—Another factor that very definitely slows up the activity of a colony at the beginning of the clover flow is that the vertical distance from the top of the brood frames to the bottom surface of the queen excluder is so great that the bees cannot pass freely through the queen excluder until burr comb has been built in. Such burr comb offers "stairways" so the bees can enter the supers easily. This burr comb should never be scraped off during the honey flow, because the storing activities of the colony will be slowed down until new burr comb can be built. Burr comb between supers is generally built during a good honey flow. This burr comb makes it easier for the bees to pass from super to super, and should be left there during the harvest period.

SUPPLYING STORAGE SPACE

In the discussion of swarm prevention and control measures the subject of giving room to bees has been partially covered. Also under the heading of colony morale the importance of supplying room in the right quantity and position was taken up. To complete the discussion the balance of the material will be covered under the heading of different systems for honey production.

Systems for Extracted Honey Production

THE DEMAREE SYSTEM.—This system is best adapted to areas where the clover flow is intense and of short duration, as with alsike, white dutch, or yellow sweet clover. It is very effective in insuring prompt occupation of the supers, and is also very reliable as a swarm control measure during the early part of the honey flow, but, because of the 1-story brood nest, vigorous queens become crowded for breeding space, which is conducive for later swarming preparations in cases where the honey flow is of long duration. It is often necessary to remove four or five frames of brood during the latter part of the flow to control swarming. These frames of brood may be used to strengthen weak colonies or for making increase. The brood nest management involved in this system insures adequate colony strength for a honey flow of 4 to 5 weeks, but is not adapted for a honey flow of long duration where it is necessary to maintain a strong field force for a long period.

By referring to the diagrams in the chart on the Delayed Demaree system (pages 16-17) a general idea may be obtained as to the brood nest and super arrangement. In the Demaree system, the brood nest and supers are arranged at the beginning of the clover flow, which in central Ohio is about June 5 to 10.

THE DELAYED DEMAREE SYSTEM.—This system is a modification of the Demaree system and embodies reducing the colony to a 1-story brood nest after the clover flow has actually been in full swing for from 10 to 15 days. By such management, ample breeding space is provided to insure a strong field force of bees for a honey flow of longer duration. It is especially well adapted for western Ohio where the sweet clovers prolong the harvest period, and is exceedingly effective for the control of swarming. After colonies have been supplied four hive bodies over the queen excluder, top-supering should be practiced. Study the chart carefully for brood nest and super arrangement (see pages 16-17).

THE MARKHAM SYSTEM.—There are some modifications of this system. The original system utilizes a 2-story brood nest throughout the harvest period. Reversing the position of the brood hive bodies is resorted to as a *swarm prevention measure* previous to and during the honey flow. The success of the system depends on expert management, which involves reversing the hive bodies and manipulating supers a "step ahead" of the needs of the colonies. The criterion to follow is to reverse the hive bodies as soon as the queen has the upper hive fairly well filled with brood. This upper hive body should be placed on the bottom board, and the hive body formerly on the bottom board placed on top under the queen excluder. Thus the hive body under the queen excluder always has plenty of comb space for the queen's egg laying activities, and the presence of the queen, laying heavily, in this region, tends to colony morale.

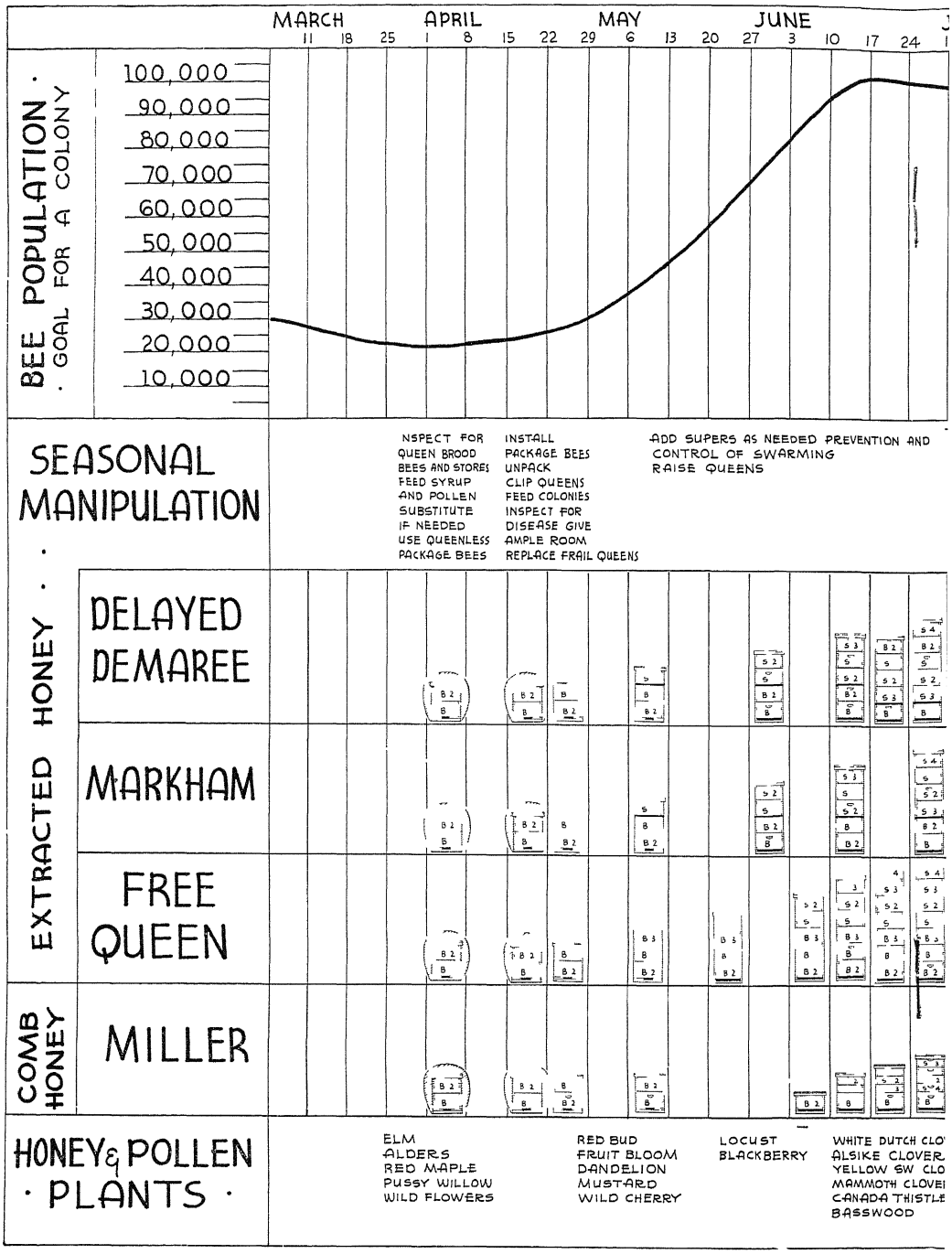
The normal reaction of a queen is always to establish her egg laying activities in the upper hive body as long as there is room there. This is highly desirable during the honey flow, as such a condition stimulates the bees to enter supers better and to store well. In cases where queens lack vigor or are beginning to fail, there is a decided tendency for the bees to crowd honey in the upper brood chamber. This is often correlated with poor storage in the supers. When such a condition is encountered during the first two-thirds of the honey flow, the beekeeper should arrange the colony according to the Demaree system (refer to chart for Delayed Demaree system, pages 16-17) and at the same time provide for a new vigorous queen.

The honey flow usually tapers off gradually, and the upper hive body of the 2-story brood nest will be well filled with honey. That is, it is natural for the queen to slow up egg laying during the last of the flow, and, as a result, she is gradually crowded out of the upper hive, because of storage of honey. However, if the honey flow shuts off suddenly, there is danger that the upper hive body will not be as full of honey as is desirable. Where there is a fall flow, these partially filled hive chambers will be well filled for the winter and spring needs of a colony. Where there is no fall flow, such colonies must be checked carefully for stores, and if stores are inadequate, the colonies should be fed sugar sirup. Refer to the chart for manipulations for the Markham system (see pages 16-17).

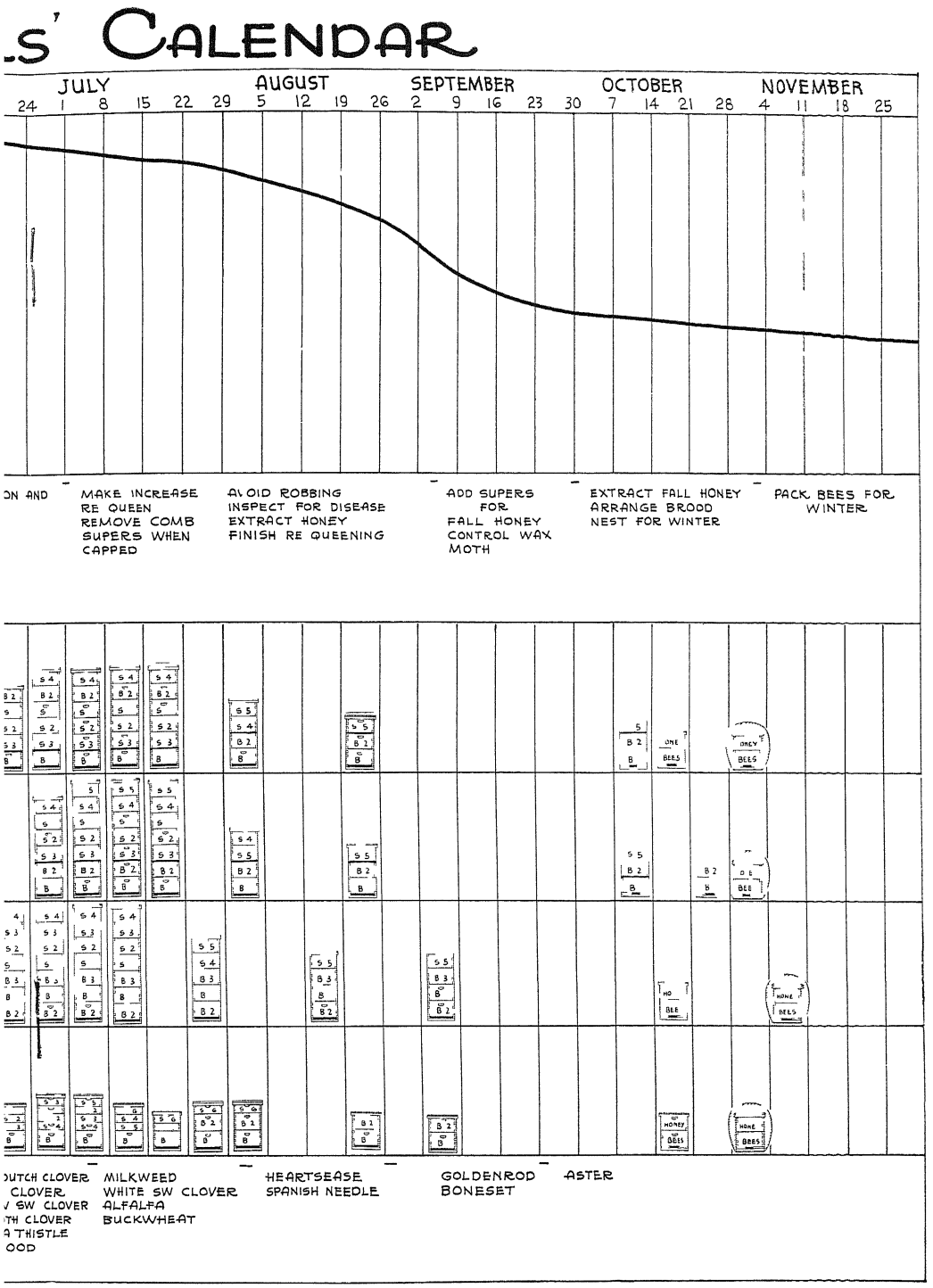
THE FREE QUEEN SYSTEM.—In the spring, as soon as the queen has filled the upper hive body full of brood, the two hive bodies should be reversed. After this manipulation, the upper hive body will be partially filled with brood in a short time. Then it is time to add a third hive body for brood rearing. Supers are added in advance of the flow and the queen is allowed to enter them and carry on her egg laying.

If the honey flow is intense and the super room is being filled, the queen is gradually crowded down into the lower brood chambers. When the nectar flow is light, there is objection to the queen extending her brood nest into the supers and remaining there. This management results in exceptionally strong colonies possessing wonderful storage morale. Many beekeepers allow the queen to extend her activities to whatever hive body she desires, and then about July 14 to 20 confine her to a 1- or 2-story brood nest by means of a queen excluder.

BEEKEEPERS



This calendar is a modification of the one used in Extension Bulletin 228, Michigan State College,



College, "Seasonal Management of Commercial Apiaries" It has been adapted to suit Ohio conditions

The objections to the Free Queen system are (1) the extra time required to examine all combs to be sure that the queen or brood is not removed with the honey (2) the increasing numbers of supers that will contain dark combs, which are not conducive to the lightest colored honey, and (3) the danger of building up a disease hazard from dark extracting combs (see chart, pages 16 17 for detail manipulations)

If the queen is confined late in the season to a definite brood nest, the supers at this time of manipulation are arranged by the orthodox method (see page 17) and supering thereafter is by the top supering method In cases where the queen is given an unlimited brood nest, the top supering method is used throughout the honey flow

When skilled labor is scarce, the Free Queen system is highly recommended as colony strength and high average surplus yields will be assured

The Long System—This system is quite similar to the Markham system except when the colony has attained good strength just previous to the flow or soon after it has begun, a third hive body of drawn combs is inserted between the two brood hive bodies and the colony allowed a 3 story brood nest during the harvest period This system is highly commendable, since the queen has ample brooding space, yet is confined by means of a queen excluder to a definite brood area At the end of the clover flow, the third brood hive body and sometimes the second brood body are full of honey

The Top Supering System—This system is best adapted to areas where the honey flow commences rather late and where the bulk of the honey is harvested from sweet clover and alfalfa For best results, place supers on colonies in advance of their needs In years of a light honey flow, there is a tendency for the bees to confine brooding activities to the upper brood nest, which results in lack of sufficient stores To correct this, place the upper brood nest (around July 15) over the queen excluder and confine the queen to the lower 1 story brood nest

The management of the brood nest is the same as for the Markham system up to the beginning of the honey flow This system is not foolproof in meeting conditions that bring about swarming When it is evident that there is a swarming problem in the apiary, colonies should be checked In colonies making preparations to swarm, evidenced by the presence of queen cells in advanced stages, the upper hive body of the brood nest should be removed and another hive body containing drawn comb given in its place All queen cells must be removed at this time The upper body which contains brood without the queen is placed on top of the supers

In both the Free Queen and the Top Supering systems much labor is saved by using the top supering method The top supering method used in both these systems insures surplus honey of heavier consistency than by the other systems outlined

Comb Honey Production

The majority of small beekeepers produce comb honey. The problems of the prevention and control of swarming and the proper supering during the honey flow demand more time and skill than in extracted honey production (refer to chart on Miller system for comb honey production). Colonies occupying two or more brood hive bodies at the beginning of the clover flow should be reduced to a 1-story brood nest. This single story brood nest should contain frames of emerging brood and the queen. Colonies of medium strength should have one comb honey super added at the beginning of the clover honey flow, and colonies strong to extra strong should be given at least two comb supers. Queen excluders are not used in comb honey production (Fig. 8).

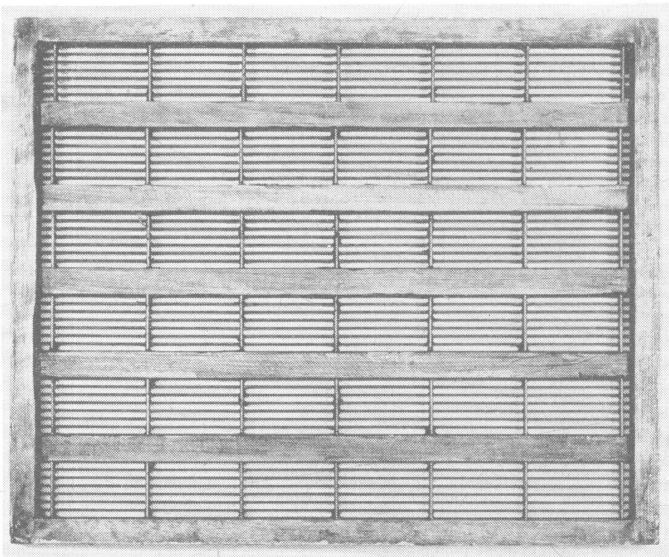


Fig. 8.—A queen excluder ,used in extracted honey production only.

The extra hive bodies of brood secured at the time of reducing the colony to a 1-story brood nest can be used for making increase or for stacking over weak colonies—at the close of the clover flow each brood hive body filled with honey must be returned to the colony to provide a deep food chamber. All colonies should be checked carefully for American foulbrood before carrying out these manipulations.

Prevention and Control of Swarming

In comb honey production, colonies must be examined every 7 or 8 days throughout the honey flow. On the first inspection, 7 days after the supers have been put on the colonies, many colonies will be making preparations for swarming, as shown by the presence of queen cells. When queen cells are found, they

should be cut out. Another serious condition that may be found is that some of the colonies have not entered the comb supers to draw foundation and store nectar. Such colonies can be enticed into a super by exchanging its super with one from a colony that has drawn the foundation.

On the second inspection, 14 days from the time supers were placed on the colonies, swarming preparations will be evidenced by the presence of queen cells in various stages. Unless the swarming impulse is removed, honey storage will not proceed properly. The following swarm control measures may be applied, depending on the condition within the colony.

Artificial Swarming Method.—If the colony is strong, storing well in the supers, and contains a vigorous queen as is evidenced by her heavy egg laying activities, the following procedure is recommended. Set a new hive body containing full sheets of foundation or drawn comb on the location of the swarming colony. Find the queen and place her, along with a frame of brood, in the center of the new hive body. Shake all except two frames of bees from the parent colony into the new, and at the same time, place the supers from the parent colony on to the new hive swarm. The old parent colony containing the brood and two frames of bees can be placed in a new location for increase, or the hive body of brood may be placed on a weak colony.

In cases where beekeepers do not have sufficient equipment for this method or do not desire to increase their number of colonies, the *Dequeening method* will work equally well (see below).

The Dequeening Method.—In colonies containing queen cells but where the evidence of a failing queen is present, as is shown by the fact that she is restricting her egg laying activity, there is only one method that can be used to control swarming and at the same time obtain good honey production—the queen cells should be removed and the queen killed. Ten days later, cut out all queen cells and introduce a young laying queen.

Later Swarm Control Measure.—After two-thirds of the clover flow is over, neither the Artificial Swarming method nor the Dequeening method should be used. Simply cut out all the queen cells.

Supering Colonies for Comb Honey

It is very important that beekeepers have a general idea of the average duration of the honey flow for their locality, and of the average amount of surplus that may be expected. The general plan of supering involves a rather rapid expansion of the storage space during the first half of the honey flow, followed by adding room sparingly during the last half of the honey flow.

At the beginning of the honey flow, as soon as the colony has drawn the foundation in the outside rows of the sections in the super, this super should be raised and another put under it. This general plan should be followed during a good honey flow until there are three or four supers on the colony. The heaviest super should occupy third position over the brood nest until it is full, then it is raised up and the next fullest super placed in third position. If the colony is strong and the honey flow intense up to the time when the honey flow

is two-thirds over, an empty super should always be kept in "top position" as a safety valve in case more storage space is needed.

From the time the honey flow is half over until the end of the flow, special emphasis should be placed on getting the supers completed as rapidly as possible. As soon as the sections are capped over in the supers, the supers should be removed to avoid having the honey travel stained by the bees. Refer to the Miller method in chart, pages 16-17.

. . . FALL MANAGEMENT OF THE APIARY . . .

The primary object in fall management of the apiary is to develop strong colonies, possessing a large number of young, vigorous bees. Equally essential is providing adequate stores and pollen to meet the requirement of the colonies during the winter and early spring periods. The fall period is without doubt the most critical period of the "beekeeper's year" because it is during this period the foundation must be laid in preparation for the next year's honey crop. Important factors insuring young bees for the winter period are:

THE QUEEN.—A good vigorous queen is the "heart" of any colony. Too much emphasis cannot be placed on the importance of young vigorous queens from proven stock heading colonies in an apiary. Probably no other factor has a greater influence with the success of the beekeeper.

Normally, the majority of young bees for the winter period are reared during the month of September and early part of October. Brood rearing should not be interrupted during this period by the introduction of a queen to a colony, unless the queen in the colony is doing a poor job of egg laying. Requeening colonies should be completed previous to September, or such work delayed until the goldenrod or aster flows are almost over.

COMB SPACE.—The minimum amount of comb space for brood rearing during the fall should be at least equal to four to six standard frames. Should the brood nest become "honey-bound" or "pollen-bound," thus limiting normal egg laying by the queen, the colony will enter the winter period heavy in honey but weak in young bees. A 2-story brood nest will build a stronger colony and favors more storage of pollen reserves.

STORES.—At no time should a colony be allowed to have less than 20 pounds of honey in the hive. Equally important are pollen reserves in the combs to insure a "balanced ration" for the young bees. A shallow food chamber is recommended in areas where fall honey is harvested, and a deep food chamber in localities where no fall honey is harvested. The use of a food chamber provides an abundance of food and will pay for itself many times. Much of our winter loss may be traced directly to the early fall period when there was a dearth of food, thus preventing colonies from rearing normal amounts of young bees.

A food chamber system of beekeeping meets cases of emergencies, and eliminates the hazards which are likely to occur when periods of drouth prevail during the fall, limiting the normal amount of nectar and pollen gathered by bees.

Management for Fall Honey Production

The goldenrod nectar flow normally covers the first three weeks of September and the aster flow the latter part of September and first half of October. Because of frequent unfavorable temperatures prevailing during the yielding period of these plants, comb honey production should be discouraged. However, fairly good results in producing comb honey may be obtained from goldenrod flow in areas where this plant has demonstrated a dependable intense flow of nectar over a period of years.

The Goldenrod Honey Flow.—Heavy brooding during a goldenrod nectar flow is generally characteristic of colonies, thus insuring strong colonies for the winter period. Usually, little difficulty is experienced in getting the goldenrod honey properly ripened, and, as a result, a good quality honey is assured for winter stores. Top-supering of the colonies should be followed, as this will give the bees a better opportunity of ripening the honey as well as encouraging storage of larger quantities in the brood nest.

The Aster Nectar Flow.—A definite problem is usually encountered in ripening aster nectar, because of the frequent cool and rainy weather conditions prevailing during the aster flow. To overcome this difficulty, the adoption of a different type of management is desirable. By placing the inner cover over the queen excluder, with only the bee escape opening available for the bees to pass through for storing nectar, two important ends are accomplished. First, the colony will crowd the brood nest with aster honey, which will insure ample stores for the winter. Second, since the majority of the bees will be crowded into the brood nest, the chances are better that the bees will properly ripen the aster honey so it will provide safe food for winter consumption. If the aster flow is intense and temperatures favorable, the bees will store surplus quite readily in the supers above the inner cover. The crowding of the bees in this way will not result in swarming. Top-supering should always be followed.

Management for Queenless and Weak Colonies

Queenless Colonies.—These are seldom worth attempting to winter, because the bees are usually old. Such a colony should be united to one of medium strength by the "newspaper method." This consists of removing the inner cover of the queen-right colony, placing a single sheet of newspaper over the top of the hive, and setting the hive body of the queenless colony on the newspaper. It is essential in warm weather and desirable in cool weather to punch holes with a nail through the newspaper. The holes provide ventilation and communication for the bees between the two hive bodies. The bees gnaw through the paper and thus allow gradual and safe uniting of the two colonies.

Weak Colonies.—If covering only two to four frames, these should be united to colonies of medium strength, or stronger. The newspaper method of uniting is recommended (see above). Tests show that 75 to 90 per cent of the queens in the upper hive body, or weak colony, survive when two colonies are united. This suggests that, in cases where the weak colony possesses an old or

inferior queen, the beekeeper should remove her to insure survival of the desirable queen located in the lower hive body.

A colony to which a queenless or weak colony has been united should be checked in 7 to 8 days. It is *extremely* important to check the amount of honey in the upper hive body. If the upper hive body contains 40 to 50 pounds of honey, it can be left and the colony wintered as a 2- or 3-story colony. Should the upper hive body be light in honey, it should be *removed* or the position of the two hives reversed so that the hive body full of honey will be on top.

Stores for Wintering Bees

An abundance of stores properly located in the hive plays an important role in the successful wintering of bees. As the bees move upward during the winter months, there should always be an adequate supply of honey above the cluster. A beekeeper, who has weathered the economic storms, says: "Either pack your bees in honey or in chaff." Packing your bees in honey and chaff for the winter will give uniform, satisfactory results even under the most adverse wintering conditions.

Quantity of Stores.—For the inexperienced beekeeper, it is often difficult to estimate the amount of stores in hives. Colonies in a 1-story hive should contain the equivalent of at least seven solid frames of honey. A single frame of honey usually is estimated at 6 pounds. Where combs are heavily filled with pollen, due allowance for the extra weight must be made when estimating stores. A 1½-story hive should have at least 55 pounds of honey, and a 2-story hive, a minimum of 60 pounds. This amount of honey should take care not only of the winter needs but also of spring needs.

Again, to further emphasize the need of an abundance of winter stores, it is important that the bees always have honey above the winter cluster. Otherwise, they will starve during a cold period, because of their inability to move sideways in the hive at low temperatures.

Quality of Stores.—If the bees have clover, buckwheat, or goldenrod honey for stores, they are assured of a fine quality food for the winter. Aster honey or other late gathered fall honey may be of inferior quality because of the bees' inability to thoroughly ripen it. Inferior winter stores may also be due to honeydew. In cases of inferior stores, the quality may be corrected by feeding sugar sirup; usually 10 to 15 pounds will suffice for each colony.

Feeding Sugar Sirup to Bees.—Sugar sirup is recommended for winter food in cases where there is a deficiency in quantity or quality of stores. All feeding operations should be completed by October 20 to give bees time to ripen the sugar sirup for winter food. The sugar sirup should be made as thick as possible to relieve the bees of much of the work of reducing the water content of the sirup to nearly that of normal honey. The following recommendations are made for preparing and supplying sugar sirup to colonies:

1. Make the sirup in the proportion of 2 parts of sugar to 1 part of water.
2. Measure the desired volume of water and heat it to the boiling point. Pour the correct volume of cane sugar into the water and stir until the sugar has

been dissolved The sirup should be removed from the stove as soon as the solution reaches the boiling point

3. Add 1 tablespoon of tartaric acid for each 50 pounds of sirup

4 When the sirup has cooled to 100 to 115 degrees Fahrenheit, pour it in 10 pound honey pails

5 In each friction top lid punch 8 to 12 holes the size of a *frame nail.* After holes have been punched in the covers, replace the covers on the pails.

6 Invert the honey pail containing sirup directly over the top of the frames of the colony. With medium to strong colonies, supply at one time all the pails of sirup they need Sirup should be given colonies late in the afternoon and when the temperature is above 60 degrees

7 Place an empty hive body over the colony being fed, with the inner and outer covers on top of the empty hive body. It is desirable in times of cool weather to place burlap sacks over the pails to help hold the heat given off by the warm sirup and the colony, thus encouraging more rapid removal of the sirup by the bees

8 Be sure to have the pails set level over the frames of the hive, as otherwise when the sirup gets low in the pail, the last portion may run out over the bees

. . . WINTERING THE BEES . . .

The annual winter loss of bees throughout the country amounts to about 14 per cent In addition, many thousands of colonies are weakened from poor wintering Therefore, successful wintering of bees is of great importance to every beekeeper

A 5-Year Survey on Winter Losses in Ohio

Through the cooperation of Ohio beekeepers, it has been possible to gather some valuable data on the extent of winter-killed colonies The following summarized table shows the losses from the winter of 1935-36 through 1939-40

Table I —Ohio Winter Bee Losses for a 5-year Period

Winter	Unpacked Colonies		Packed Colonies	
	Number of Colonies	Per Cent of Winter Loss	Winter Loss Number of	Colonies Per Cent of
1935-1936	4,269	34 9	7,255	17 07
1936-1937	4,017	4 5	11,334	2 9
1937-1938	4,550	11 6	10,513	8 0
1938-1939	7,710	4 6	10,319	4 1
1939-1940	10,339	30 4	11,909	12 9

Protection for Bees

Adequate protection during the winter and early spring is important to insure good wintering of bees and colony development during April Protection may be classified under two groups: (1) wind protection, and (2) insula-

tion around the hives. By the application of efficient fall management and proper protection during the winter, losses may be reduced to not over 1 to 5 per cent for a period of years.

Wind Protection.—One of the essential points in selecting an apiary site is protection against prevailing winds. An ideal site is one surrounded on three sides by low shrubbery which will aid in reducing wind currents to the minimum.

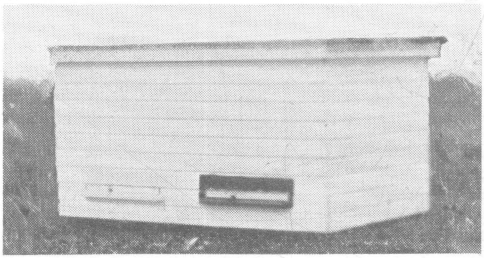


Fig. 9.—Two-colony wooden packing cases.

Insulation for Hives.—Packing materials which are easily available, and very satisfactory are: Leaves, clover chaff, chopped oat or wheat straw, and shavings and sawdust mixed. Packing materials should be dry for greatest insulating effectiveness. For Ohio conditions, there should be about 3 inches of packing material on the sides and ends of the hives and 6 to 8 inches of top packing, Fig. 9).

Beekeepers planning to pack colonies for winter should complete this operation before cold weather commences—October 25 to November 5 is the best time for packing. The asphalt paper packing case is highly recommended, as it is economical as far as material and labor are concerned. It is important to get the *asphalt* "slater's felt," as this type of paper is durable and is fairly flexible during cool weather (Figs. 10 and 11). The procedure for packing is as follows:

1. Remove the telescoping covers from the hives and push the two colonies closely together, side by side.

2. On each hive tack a piece of board ¾ inch by 2 inches by 16 inches on top of the bottom board extending in front of the hive. This will provide a winter tunnel ⅞ inch deep by 14½ inches wide by 2 inches long.

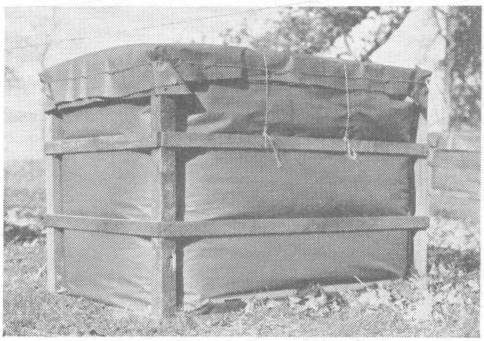


Fig. 10.—Two-colony asphalt paper case.

3. Pack with insulation material under the hives and under the bottom board extending beyond the front of the hive. Some beekeepers place asphalt paper on the ground under the hives. The paper keeps the underpacking dry, a condition much desired for winter protection.

4. Cut a strip of asphalt paper of sufficient length to go around the two hives and allow for a liberal overlapping at the back. A strip 11 feet long is about right. The ends of the strip are overlapped about 5 inches and cemented together with hot asphalt or pinned together with 10-penny nails.

5. Stand paper on edge and slip it over the two colonies so that the lower edge rests on the ground. The paper is nailed to the front of the hive by a narrow strip of wood across the upper edge of the tunnel and another strip of wood to the lower edge of the tunnel.

6. Pack the insulating material at the corners first so that a well-shaped pack results. Insulating material on the sides, back, front, and top should be packed firmly.

7. Fold the paper from the back and front to the center of the pack. Following this, the paper on the sides is folded toward the center. To hold the folded paper in place on top of the case, take nails and pin the overlapping paper at each corner.

Fig. 11.—A yard of bees packed by the "two-colony asphalt paper case" method with wooden racks to support the asphalt paper.

8. A cover must now be prepared for the packing case. Cut a strip of paper long enough so that when it is folded it will make a strip of two thicknesses which will extend down at least 8 inches on each side of the packing case.

9. Place the two thicknesses of paper over the case. With binders' twine, tie two strands around the upper portion of the case so that the cover will be held securely. As a further precaution in holding the paper cover, twine can be tied from the lower back corners of the hive diagonally across the top to the lower front corners.

10. The entrance pieces are now pushed through the paper into the tunnels. The size of the winter entrance should be $\frac{5}{16}$ inch by 4 inches. It is desirable to place the entrance piece so that the entrance opening of each colony will be as far apart as possible to avoid intermingling of the bees between the colonies.

11. The ordinary factory entrance piece permits mice to enter hives. This can be prevented by nailing a small piece of wire screening (mesh screening of three wires per inch) over the entrance opening of each colony.

12. If your colonies are wintering on fall honey, more upward ventilation may be desired. This can be provided by placing two thicknesses of burlap over the bee escape opening in the inner cover and over this wire screening to prevent mice entering the colony.

Wintering Colonies Without Packing

To winter colonies successfully without packing demands a thorough understanding of all the factors that determine the development of colony population and the ability to apply this knowledge from a practical standpoint. At the beginning of the winter period, colonies must be strong in young bees, have a minimum of 60 pounds of honey, three to five frames of pollen reserves, a young vigorous queen, and a 2-story hive—or better, a 2½-story or 3-story hive.

To further emphasize the importance of an abundance of honey with this type of wintering it is almost essential under Ohio conditions that colonies possess 75 to 85 pounds of honey—preferably clover honey. If an unprotected colony gets caught during a long sub-zero period without stores above the cluster, they will starve—since, as has already been pointed out, they are unable to move sideways for stores during such a period (Fig. 12). Also, there is more brood-rearing in unprotected colonies, and such colonies may consume from 15 to 25 pounds more stores during the winter than packed colonies.

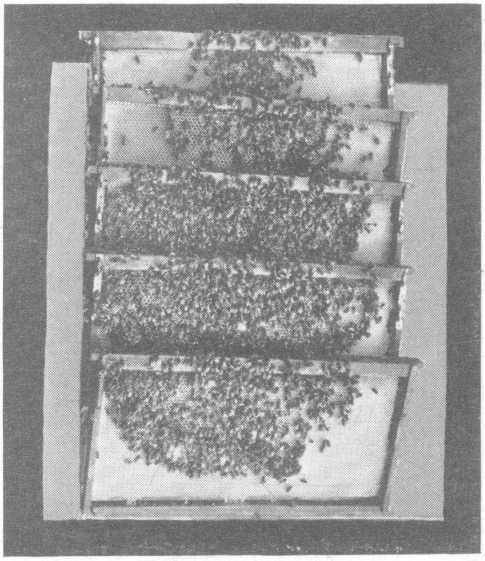


Fig. 12.—A dead winter-cluster of bees. If the empty white combs had been placed under a hive body full of honey during the late fall period, the bees would have wintered successfully.

Protection from prevailing winds is very important, yet of equal importance is to have the colonies located so that the sunshine will hit them. Low shrubbery on three sides of the apiary will give good protection and yet allow full sunlight on the colonies.

The entrance should be reduced to 1½ inches in length by 5/16 inch in depth. If the depth of the entrance is greater, wire mesh screening should be tacked over the entrance to prevent mice entering the hive. A ⅝-inch hole should be bored through the second story just under the "hand hole" to allow

for upward ventilation and for an upper entrance for the colony. The average beekeeper will suffer greater winter losses in unpacked colonies than with packed colonies. Such losses can be made up easily by buying package bees and queens from a southern shipper each spring.

. . . FOOD CHAMBERS . . .

The adoption of a food chamber system of beekeeping avoids many of the "ills" common to beekeeping; such as the starving of colonies, or the restricting of brood rearing in late spring, the restricting of the normal amount of brood reared during late August and September, and the winter-killing of colonies because the stores are inadequate or improperly located in the hive.

For the commercial beekeeper who must give the minimum amount of individual attention to each colony, the food chamber system of beekeeping is almost indispensable. In areas where there is a good fall flow nearly every year, a shallow food chamber 5⅜ inches deep is recommended. The shallow food chamber full of honey is left on the colony at the end of the clover flow. During the fall flow, the brood nest is partially or nearly filled with aster honey, which means that such a colony entering the winter will have from 50 to 75 pounds of honey. This amount of honey is ideal for wintering and insures normal brooding of the colony during the following spring.

In areas where there is little or no fall honey flow, a deep food chamber should be left on each colony, which would mean about 60 pounds of honey. This amount of honey is hardly enough and will necessitate the feeding of sirup in some years. It is wise to have about 40 well filled shallow food chambers in reserve for each 100 colonies. These shallow chambers can be set on any colony needing extra stores.

Loss in colony strength, loss in labor and efficiency, especially in the management of a commercial outfit often is due to insufficient quantities of honey and pollen. The food chamber system of beekeeping largely overcomes these difficulties.

. . . QUEENS AND REQUEENING . . .

When stocking the apiary, it is highly important to procure bees that are hardy, good producers, prolific breeders, gentle, and resistant to American foulbrood. Every beekeeper should select his stock with painstaking care, as the requirements to best fit the needs of his particular locality may differ from those of other producing areas.

When Should Colonies be Requeened?

For the small or average sized beekeeper, annual requeening should be followed. One exception to this general rule is recommended—that is, any queens heading colonies that have given exceptionally good records should be held for the second year as a means of supplying breeding queens and high quality drones, in an effort to improve the stock in the apiary. Of course, whenever any of these older queens show signs of failing they should be replaced.

For best results, all requeening operations should be completed by the close of the clover flow, or not later than August 10. The smaller beekeeper can use ripe queen cells or use laying queens during the period July 15 to August 10. This will mean that often a portion of the surplus honey will have to be lifted off the hives, requeening operations applied, and the surplus honey replaced on the hives. For the extensive commercial beekeeper this would require so much time that he cannot practice requeening on an extensive scale at this time of year.

With the extensive commercial beekeepers any queen that is average or above in performance is kept for 2 years. Requeening is practiced at any time of year that queens are below average or are failing. There is a growing tendency to do as much requeening during the spring months as possible, since the equipment is light in weight and more work can be accomplished per man hour. In following this spring requeening schedule, effort is made to requeen without interrupting brood rearing. This can be done by establishing a small upper unit above a special screened inner cover, or over a closed inner cover with an entrance. As soon as the queen in the upper unit has assumed normal egg laying, she is then introduced to the lower parent colony and the old queen is destroyed.

In cases where colonies have been good producers and supersedure queen cells are found, it is advisable, where the colony strength is good, to allow the colony to rear its own queen. Such colonies should be checked as soon as the new queen is likely to be laying to see if she is normal, and also to strengthen the colony if necessary. In extracted honey production during the clover flow, little swarming results from queens being superseded during the last half of the flow. In fact, it is desirable to have them do so, as the resulting queens are the finest to be obtained. All queens reared from cells should be laying by August 10. Any colonies found to be superseding their queens after August 10 should have the queen cells cut out and a young laying queen introduced, as time will allow only for the new queen to re-establish a normal bee population before the beginning of the winter period.

Some Safe Methods of Requeening

The successful introduction of queens to colonies is influenced by a number of factors such as weather, availability of nectar and pollen, number of young bees, temperament of the colony, and many other conditions that may prevail within a colony. Three methods of introducing queens are listed:

Method I

The most common method used is the introduction of queens with the mailing cage in which they are sent from southern breeders. This queen cage has some fondant candy in one end with a cardboard over the end of the cage. This candy not only furnishes food for the queen and her attendants, but also is the means of introducing the queen to a colony. The usual procedure is as follows:

(1) If there is no nectar flow, the old queen is removed from the colony and any queen cells cut out. Six to eight days later all queen cells are cut out and the new queen introduced. The cardboard over the end of the queen cage

should be removed Normally, it takes the bees from 30 to 48 hours to eat through the fondant candy and release the new queen

(2) If there *is a nectar flow* even though it is a light flow, the new queen is introduced to the colony immediately after removing the inferior queen

It is important not to have a colony queenless for any longer time than is possible, since any eggless period of even a short duration affects the colony's population A way to speed up the introduction of a new queen to a colony during a period when no nectar is being gathered, is by feeding a colony 10 pounds of thin sugar sirup at the time of removing the old queen, and then introducing the new queen immediately With queenless colonies, new queens can be introduced immediately but, in a case of no nectar flow, supplying sirup to the colony is important

Method II

The use of the ordinary introducing cage in which the queen is shipped does not always prove successful Probably the average beekeeper obtains not more than 85 per cent acceptance through the use of the common introducing cage The following method will be successful even under adverse conditions and will result in approximately 100 per cent acceptance

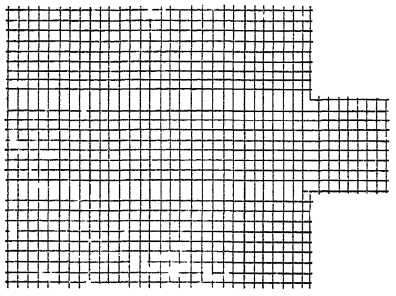


Fig 13.—Heavy hardware screening cut for a supplementary push in cage

SUPPLEMENTARY PUSH IN CAGE — The push in cage, which is used with the ordinary mailing queen cage, is made from a stiff wire screening As shown in Fig 13, the screen should be cut the *length* of the mailing queen cage, plus thickness of queen cage plus ⅜ inch The *width* should be equal to the width of the queen cage plus twice the depth of the cage plus ½ inch At one end of the supplementary cage a *square* piece (depth of mailing cage plus ⅜ inch) is cut from each corner (see Fig 13) The dotted lines indicate where the screen should be folded, thus making a cage which will fit over the mailing queen cage as seen in Fig 14

INTRODUCING THE QUEEN—The old queen is removed from the colony along with any queen cells that may be present Select a place in the central part of the brood nest where there are empty cells Remove the perforated metal on the end of the mailing cage and place the cage on the comb so the open end is in a slightly downward position Then place the supplementary push in cage over the mailing cage as shown in Fig 15

Precautions must be taken that the open end of the push in cage fits tightly over the mailing cage, and also that the edges of the sides of the supplementary cage are inserted to the mid rib of the comb to prevent the premature escape of the queen The pasteboard on the end of the cage containing the queen candy should *not* be removed if there is no nectar flow, otherwise, remove the pasteboard In a normal colony, it will require 2 to 3 days for the bees to

gnaw through the pasteboard and eat through the queen candy. This is sufficient time for the queen to start egg laying on the comb enclosed by the push-in cage and for the bees to accept her before coming in direct contact.

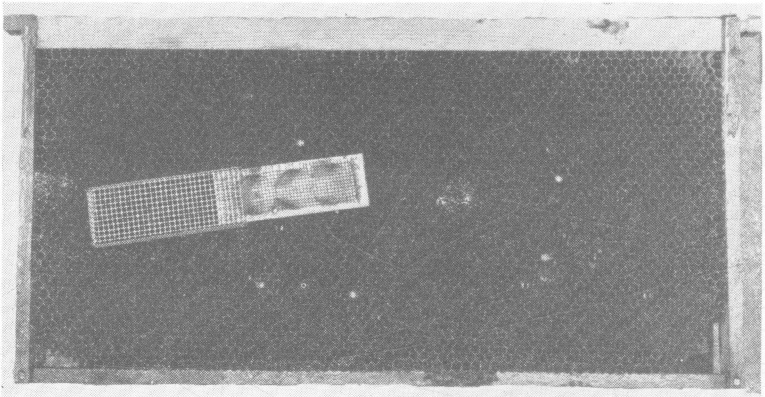


Fig. 14.—Attachment of the supplementary push-in cage to the standard mailing queen cage.

Method III

This method necessitates the maintenance of three-frame nuclei hives (Fig. 15) or upper units over colonies to provide for a constant source of young laying queens. For best results, the beekeeper should plan for about 8 per cent of these queen-mating hives for every 100 colonies managed for honey production. By buying laying queens, such queens can be introduced to these nuclei hives or upper units by the beginning of the dandelion-fruit bloom. As the season progresses. the beekeeper can rear ripe queen cells, virgins, or buy queens from the south to maintain a constant supply of fresh laying queens.

There is one chief disadvantage of this method of introduction and that is there must be a nectar flow in order to get good acceptance. When a colony becomes queenless, or if a colony is to be requeened, the beekeeper simply smokes the full sized col-

Fig. 15.—A 3-frame nucleus hive with mason jar feeder for maintaining a supply of young laying queens during the summer months.

ony lightly and then takes two or three frames of brood, bees, and the young laying queen from one of the nuclei hives and places these frames directly in the center of the colony. Acceptance is usually about 100 per cent if requeening is done during a honey flow.

The advantages of this method are: (1) the new queen has already demonstrated in the nuclei if she is normal in egg laying; (2) since the queen is well under way in her laying activities, she can quickly get into full capacity in the full size colony; (3) the percentage of supersedure of the introduced queen is very small Such treated colonies assume their normal activities in the shortest possible time Most commercial beekeepers prefer this method and attempt to maintain a constant supply of fresh laying queens for their requeening needs.

BEE BULLETINS

Package Bees for Honey Production, Agrl. Ext Bul. 159, Ohio State University.

Honeybees Increase Clover Seed Production 15 Times, Agrl Ext. Bul. 253, Ohio State University.

Diagnosing Bee Diseases in the Apiary, Cir 392, U S D A

Honey and Some of Its Uses, Leaflet 113, U S D A.

Transferring Bees to Modern Hives, Farmers' Bulletin 961, U S D A

The Treatment of American Foulbrood, Farmers' Bulletin 1713, U S D A.

The Wax Moth and Its Control, Cir. 386, U.S.D.A.

The first two of these bulletins may be secured from your County Agricultural Agent. The others may be secured from the United States Department of Agriculture, Washington 25, D. C